

## CLAIMS

1. A diamond electron emission device comprising a light emitting device for irradiating light to a cathode, wherein at least an electron emission face of said cathode is made of diamond.
2. A diamond electron emission device according to claim 1, wherein said light emitting device is made of diamond.
3. A diamond emission device according to claim 1 or 2, wherein said electron emission face of said cathode is an n-type diamond semiconductor.
4. A diamond emission device according to claim 1 or 2, wherein said electron emission face of said cathode is a p-type diamond semiconductor.
5. A diamond electron emission device according to claim 4, wherein said p-type diamond semiconductor includes crystal defects or an sp<sup>2</sup> component.
6. A diamond electron emission device according to any one of claim 1 through claim 5, wherein said electron emission face of said cathode is hydrogen terminated.
7. A diamond electron emission device according to any one of claim 1 through claim 5, wherein said electron emission face of said cathode is oxygen terminated.
8. A diamond electron emission device according to any one of claim 1 through claim 7, wherein said light emitting device is composed of a pn junction of diamond, a schottky junction or a MIS structure.
9. A diamond electron emission device according to any one of claim 1 through

claim 8, wherein said electron emission face of said cathode contains a sharpened projection part.

10. A diamond electron emission device according to any one of claim 1 through claim 9, wherein wavelength energy of light emitted from said light emitting  
5 device includes 5.0 - 5.4 eV.

11. A diamond electron emission device according to any one of claim 1 through claim 10, wherein wavelength energy of light emitted from said light emitting device is equal to or greater than 2.0 eV.

12. A diamond electron emission device according to any one of claim 1 through  
10 claim 11, wherein light from said light emitting device excites electrons in an impurity level to a conduction band.

13. A diamond electron emission device according to any one of claim 1 through claim 11, wherein light from said light emitting device excites electrons in a band gap level to a conduction band.

15 14. A diamond electron emission device according to any one of claim 1 through claim 11, wherein light from said light emitting device excites electrons in a level resulting from any of following components of p-type diamond: graphite; non-crystalline carbon; diamond-like carbon; fullerene; lattice defect; dislocation defect or grain boundary defect, to a conductive band.

20 15. A diamond electron emission device according to claim 3, wherein said n-type diamond contains as an impurity at least one element among nitrogen, phosphorous, sulfur and lithium, or any one of said elements and boron.

16. A diamond electron emission device according to any one of claim 1 through

claim 15, wherein said light emitting device is composed as one unit with said cathode.

17. An electron beam source utilizing a diamond electron emission device, wherein a light emitting device for irradiating a cathode and a cathode, in  
5 which at least an electron emission face is diamond, are disposed together in an electron gun.

18. An electron beam source utilizing a diamond electron emission device according to claim 17, wherein:

an anode is separated by a space from said cathode, in which at least an  
10 electron emission face is diamond; and

a voltage that is positive relative to said cathode is applied to said anode.

19. An electron beam source utilizing a diamond electron emission device according to claim 18, wherein a control electrode is disposed between said  
15 cathode and said anode to regulate an emission electron current from said cathode.